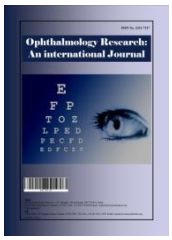

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Ocular Hypotony after Glaucoma Surgery

Heba Mohammed Ghobashy [a*], Ahmed Fekry Elmaria [a], Ahmed Mohammed Ghoneim [a] and Tarek El Mohammadi Eid [a]

[a] *Ophthalmology Department, Faculty of Medicine, Tanta University, Tanta, Egypt.*

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Postoperative hypotony is associated with choroidal effusion, suprachoroidal haemorrhage, aqueous misdirection syndrome (malignant glaucoma), choroidal folds and hypotony maculopathy, anterior chamber (AC) shallowness or loss and subsequent failure of the original filtration of procedure. This work aimed to study the causes, risk factors, adverse effects, and management plans of ocular hypotony after different glaucoma surgeries.
Methods: This retrospective study was carried out on 205 eyes underwent glaucoma surgery with follow up for more than 3 months. Patients were divided into two groups: 30 cases were diagnosed with post-operative hypotony, 175 eyes were without hypotony. Patients were subjected to glaucoma diagnosis, type of glaucoma operation and recorded IOP for 3 months at least.
Results: CPC, Visco-Trab, Phaco Visco-Trab Visco and express valve were significantly different between the two groups (P=0.049, P=0.012, P=0.043 and P<0.001 respectively) and other types of operation were insignificantly different between the two groups. IOP was significantly decreased at first diagnosis of hypotony and at last follow up compared to before operation (P value <0.001). IOP at last follow up was significantly increased compared to first diagnosis of hypotony (P value <0.001). Criteria of hypotony eyes were insignificantly different between patients needed surgical intervention and no surgical intervention.
Conclusions: Postoperative hypotony was most common in pseudo-exfoliative glaucoma cases compared to other glaucoma types. While the most type of glaucoma surgery that was associated with postoperative hypotony was viscocanalostomy combined with express shunt. The adverse effects reported in our study were choroidal effusion and hypotony maculopathy.

**Corresponding author;*

Keywords: Ocular hypotony; glaucoma; surgery.

1. INTRODUCTION

Hypotony is a term that can be defined statistically and clinically. Hypotony is defined statistically as an intraocular pressure (IOP) less than 6.5mmHg, which is more than three standard deviations lower than the mean IOP. Hypotony is defined clinically as an IOP that is low enough to cause vision loss. While acute and transient clinical signs and symptoms are usually reversible, chronically decreased IOP can have a detrimental effect on the morphology and function of intraocular tissues [1].

Hypotony can be caused by an increase in the outflow of aqueous humour or, less frequently, by a decrease in the ciliary body's production of aqueous humour. Increased outflow can occur as a result of a surgical wound leak, an excessive filtering bleb, a cyclodialysis cleft, or a scleral rupture, among other causes [2].

The ciliary body typically produces less aqueous humour under inflammatory conditions [3].

Hypotony can be encountered in the ophthalmologist's practice, with many cases being caused by various types of glaucoma surgery such as subscleral trabeculectomy use of adjunctive antifibrotic agent, glaucoma drainage devices, and cyclodestruction procedures [1].

Hypotony is a considerable complication of filtering surgery that has been associated with a delayed visual recovery. Low IOP-related vision loss can be attributed to a variety of factors, including corneal edema, astigmatism, and cystoid macular edema [4].

Postoperative hypotony is associated with a high incidence of choroidal offusion, suprachoroidal haemorrhage, aqueous misdirection syndrome (malignant glaucoma), choroidal folds and hypotony maculopathy, anterior chamber (AC) shallowness or loss and subsequent failure of the original filtration of procedure [5].

Maculopathy due to hypotony is a rare complication of glaucoma filtering surgery, trauma, and other anterior segment procedures. It was uncommon prior to the advent of adjunctive antifibrotic agents for glaucoma surgery [6,7].

The most significant clinical characters of persistent ocular hypotony include the following: thickening of the cornea with Descemet's membrane striae, choroidal detachment, shallow AC, tortuosity of the retinal vessels, disc oedema, and thickening and striae of the retina, including macular folds. All of these factors contribute to decreased visual acuity [8].

Numerous intra- and postoperative measures were taken to reduce the incidence of hypotony, including releasable suture, laser suture lysis techniques. [9] and/or the adjunctive use of viscoelastic material intraoperatively. Regardless of these approaches, hypotony can still occur [10].

The aim of this work was to study the causes, risk factors, adverse effects, and management plans of ocular hypotony after different glaucoma surgeries.

2. PATIENTS AND METHODS

This retrospective study was carried out on 205 eyes underwent glaucoma surgery with follow up for more than 3 months at Ophthalmology Department, Tanta University Hospital over three years from January 2017 to December 2019. Study protocol had been submitted for approval by Institutional Review Board, Tanta University and Confidentiality and personal privacy had been respected in all levels of the study.

Exclusion criteria were patients underwent glaucoma surgery with follow up for less than 3 months.

Patients were divided into two groups: 30 eyes were diagnosed with post-operative hypotony, and 175 eyes were without hypotony.

Patients were subjected to glaucoma diagnosis, type of glaucoma operation and recorded IOP for 3 months at least.

Patients diagnosed with postoperative hypotony were reviewed for: preoperative glaucoma characteristics, preoperative antiglaucoma medications, recorded note about apparent causes of postoperative hypotony, status of crystalline lens clarity, IOP, AC depth, Bleb height, macula and choroid). Specific lines of management of postoperative hypotony: (Conservative management, Surgical intervention). Criteria of success of postoperative hypotony management (4 mmHg < IOP < 22

mmHg and Visual acuity did not decrease more than 2 lines compared to preoperative value).

2.1 Statistical Analysis

Statistical analysis was done by SPSS v25 (IBM Inc., Chicago, IL, USA). Quantitative parametric data were presented as mean and standard deviation (SD) and were analysed by repeated measures ANOVA. Quantitative non-parametric data were presented as median and range. Qualitative data were presented as number and percent and were compared by chi-square (X^2) or Fisher's Exact test when appropriate. A two tailed P value < 0.05 was considered significant.

3. RESULTS

There was no statistically significant difference between sex, age and hypotony. Pseudo-exfoliative glaucoma was significantly higher in patients with hypotony (P = 0.004). Other glaucoma types were not significantly associated with hypotony Table 1.

Severity of glaucoma, previous intraocular surgeries, preoperative visual acuity, and glaucoma characteristics of hypotony patients and number of preoperative anti-glaucoma medications used in case developed hypotony after glaucoma surgery Table 2.

Table 1. Relationship between age, sex, diagnosis and hypotony

		With hypotony (n = 30)	With no hypotony (n = 175)	P value
Age (years)	**Less than 50 years**	9 (13.4%)	58 (86.6%)	0.735
	More than 50 years	21 (15.2%)	117 (84.8%)	
Sex	**Male**	19 (14.1%)	116 (85.9%)	0.753
	Female	11 (15.7%)	59 (84.3%)	
Diagnosis				
POAG		11 (14.9%)	63 (85.1%)	1.000
PCAG		5 (10.2%)	44 (89.8%)	0.315
NVG		4 (8.3%)	44 (91.7%)	0.158
Secondary glaucoma		4 (40.0%)	6 (60.0%)	0.159
Juvenile glaucoma		1 (11.1%)	8 (88.9%)	0.760
Congenital glaucoma		1 (12.5%)	7 (87.5%)	0.862
Pseudo-exfoliative glaucoma		3 (60.0%)	2 (40.0%)	0.004*
LTG		1 (50.0%)	1 (50.0%)	0.155

*Data are presented as frequency.(%) , POAG: primary open angle glaucoma, PCAG: primary closed angle glaucoma NVG: neovascular glaucoma, LTG: Low Tension Glaucoma *: significant as p value <0.05*

Table 2. Severity of glaucoma, previous intraocular surgeries, preoperative visual acuity, and glaucoma characteristics of hypotony patients and number of preoperative anti-glaucoma medications used in case developed hypotony after glaucoma surgery

		Eyes (n = 30)
Severity of glaucoma		
Advanced		14 (46.7%)
Mild to moderate		16 (53.3%)
Previous intraocular surgeries		6 (20%)
previous intraocular surgeries		
Visual acuity (log MAR) (n = 23)	**Median**	0.35
IOP (mmHg) (n = 30)		26.1 ± 11.73
Visual Field (MD dB) (n = 8)		-20.09 ± 5.87
Cup Disc (C/D) (n = 23)		0.87 ± 0.17
preoperative anti-glaucoma medications used	Single eyedrop	5 (16.7%)
	Two eye drops	10 (33.3%)
	Three eye drops	6 (20%)

Data are presented as mean ± SD or frequency (%), IOP: Intraocular pressure

CPC, Visco-Trab, Phaco Visco-Trab Visco and express valve were significantly different between the two groups (P=0.049, P=0.012, P=0.043, P<0.001 respectively) and other types of operation were insignificantly different between the two groups Table 3.

Table 3. Relationship between type of operation and hypotony.

Type of operation	With hypotony (n = 30)	With no hypotony (n = 175)	P value
Phaco trab	8 (9.6%)	75 (90.4%)	0.095
Trab	8 (20.5%)	31 (79.5%)	0.248
Ahmed valve	3 (8.6%)	32 (91.4%)	0.265
CPC	0 (0.0%)	22 (100.0%)	**0.049***
Visco-Trab	5 (38.5%)	8 (61.5%)	**0.012***
Express valve	2 (28.6%)	5 (71.4%)	0.288
Phaco Visco-Trab	2 (50.0%)	2 (50.0%)	**0.043***
Visco express valve	2 (100.0%)	0 (0.0%)	**<0.001***

*Data are presented as frequency (%), CPC: cyclophotocoagulation, *: significant P value*

Table 4. Causes of postoperative hypotony, status of the lens, AC depth, bleb's height, macula, and choroid of hypotony patients

		Eyes (n = 30)
Apparent cause	Excessive filtration	17 (56.7%)
	Leaking bleb	9 (30.0%)
	Choroidal effusion	3 (10.0%)
	Inflammation	1 (3.3%)
Status of the lens		
Types of Cataracts	clear	13 (43.3%)
	PSC	9 (30%)
	PSC + N_2	3 (10%)
	Cortical	3 (10%)
	N_2	2 (6.67%)
Intervention for cataract	Phaco trab	8 (26.67%)
	Trab	4 (13.33%)
	Phaco Visco-Trab	2 (6.67%)
	Ahmed valve	1 (3.33%)
	Express valve	1 (3.33%)
	Visco-Trab	1 (3.33%)
AC depth	Quiet, deep	22 (73%)
	Shallow/flat	7 (23%)
	Deep	1 (3%)
Bleb's height	Flat	1 (4.2%)
	Low	4 (16.7%)
	Moderately elevated	8 (33.3%)
	Highly elevated	11 (45.8%)
Macula	hypotony maculopathy	1 (3%)
	no hypotony maculopathy	29 (97%)
Choroid	Choroidal effusion	5 (16.7%)
	No choroidal effusion	25 (83.3%)

Data are presented as frequency (%), AC: Anterior Chamber depth, PSC: Posterior Subcapsular

Table 5. Time of the first diagnosis of hypotony, length of follow up, anti-glaucoma treatment and visual acuity at last follow up of hypotony patients and IOP (mmHg) before operation, 1st diagnosis after operation and at last follow up

			Eyes (n = 30)
Time of the first diagnosis of hypotony (days)		**Median**	7.5
		Range	2 - 60
Length of follow up (months)		**Median**	16.00
		Range	3-24
Anti-glaucoma treatment at last follow-up		**One drug**	3 (10%)
		Two drugs	1 (3.3%)
		Three drugs	2 (6.7%)
			Eyes (n = 22)
Visual acuity (at last follow up)		**Median**	0.60
		Range	0.004 - 1.3
IOP (mmHg)		**P1**	**P2**
Before operation	26.1 ± 11.73	**----**	**------**
1st diagnosis of hypotony	3.63 ± 1.84	<0.001*	-------
At last, follow up	10.6 ± 4.96	<0.001*	<0.001*

P1: P value compared to "Before operation", P2: P value compared to first diagnosis of hypotony, IOP: Intra ocular pressure

Causes of postoperative hypotony, status of the lens, AC depth, bleb's height, macula, and choroid of hypotony patients Table 4.

Time of the first diagnosis of hypotony, length of follow up, anti-glaucoma treatment and visual acuity at last follow up of hypotony patients and IOP (mmHg) before operation, 1st diagnosis after operation and at last follow up were shown in Table 5.

IOP was significantly decreased at first diagnosis of hypotony and at last follow up compared to before operation (P value <0.001). IOP at last follow up was significantly increased compared to first diagnosis of hypotony (P value <0.001) Table 5.

4. DISCUSSION

Hypotony is a serious complication of filtering surgery that has been associated with a delayed visual recovery. Low IOP-related vision loss can be attributed to a variety of factors, including corneal edema, astigmatism, and cystoid macular edema [4].

In our study, thirty cases were diagnosed with post-operative hypotony (14 .6%). Primary trabeculectomy was the subject of a large national survey. for POAG in the United Kingdom (UK) by Edmunds et al. [11] also found that the most frequent early complication was hypotony (n = 296, 24.3% out of 1240) throughout the first two weeks follow up.

While another study by Jayaram et al. [12] which included 131 eyes undergoing trabeculectomy showed that early hypotony occurred in (2.3%) of the cases which is in disagreement with our findings. This is due to a consequence of careful placement and tension of releasable sutures within the scleral flap, thorough testing for aqueous flow with fluorescein and meticulous conjunctival closure.

For whom final clinical outcome data were available and those for whom they were not.

The present study showed that Pseudo-exfoliative glaucoma was associated significantly with post glaucoma surgery hypotony occurring in (60.0%) of the patients. Other glaucoma types were not significantly associated with hypotony.

In a study by Prokosch-Willing et al. [13], a total of 29 eyes with hypotony maculopathy [IOP, ≤6 mm Hg] were studied. Twenty-three out of the 29 eyes had POAG, 4 had PEXG glaucoma (PXE), one had normal-tension glaucoma (NTG), and one had ocular hypertension (OHT).

Contrary to our findings, El-Saied et al. [14] found that none of the cases developed postoperative hypotony in secondary glaucoma.

It is very likely that the discrepancy between hypotony rates in our study and others are related to the poor follow up rates in the current study (i.e., patients with mild complications most

likely lost follow-up) and some data were unavailable as of the nature of retrospective studies.

Our study demonstrated that no hypotony occurred in eyes underwent trans-scleral diode laser cyclophotocoagulation. (P= 0.040). visco-trab MMC, phaco-visco-trab MMC and combined visco express valve implantation with MMC were associated significantly with post glaucoma surgery hypotony (P = 0.012, 0.043, <0.001 respectively). Other glaucoma surgeries were not significantly associated with hypotony.

Leeungurasatien et al. [15] reported on all patients who experienced at least one episode of hypotony during any subsequent visit. Some studies excluded hypotony on the first day following trabeculectomy, while others counted hypotony if a patient experienced hypotony during at least three consecutive follow-up visits [11,16].

In disagreement with our results, Seah et al. [17] demonstrated that hypotony developed in 108 (69.6%) eyes who underwent standard trabeculectomy (n = 15), trabeculectomy with postoperative 5-fluorouracil injections (n = 81), trabeculectomy with intraoperative mitomycin-C (n = 55), or trabeculectomy with both antimetabolites (n = 4). The lower incidence of post Trab hypotony in our study compared to older studies may be attributable to modifications in the use of adjunctive antimetabolites (reduced concentration and duration of application of mitomycin C) during operation.

In our study, CPC was not associated with hypotony since no cases developed postoperative hypotony. In contrast, Aujla et al. [18], studied seventy eyes with refractory glaucoma who received TSCPC treatment. Seven eyes (10%; CI 5–19%) developed hypotony. This may be due to the fact that these eyes are generally at an end stage, and the natural history of the disease would almost inevitably lead to loss of further vision and the eye overtime.

In a study conducted by Stein et al. [19], of 1292 eyes undergoing GDD implantation, 21 (1.6%) developed hypotony owing to over filtration. While our study showed that17 (56.7%) eyes, out of the 30 hypotony cases, were due to excessive filtration.

However, a study conducted in Singapore by Tan et al. [20], showed that out of 1262 eyes, the commonest complication found was prolonged hypotony (defined as IOP <5 mm Hg) was due to over filtration (23 cases [1.8%]). Followed by bleb leak (11 cases [0.9%]).

Bleb leak was the most common postoperative complication in a previous Thai study (23.2%) by Lim et al. [21].

In our study, IOP was significantly decreased at “first diagnosis of hypotony” compared to “before operation”. IOP “At last follow up” was significantly increased compared to “first diagnosis of hypotony”.

In agreement with our study, Prokosch-Willing et al. [13] showed that the mean IOP before revision surgery was significantly lower than IOP at three months after revision and the IOP at the last follow-up visit.

5. CONCLUSIONS

The most prominent causes of hypotony after different glaucoma surgeries were excessive filtration and bleb leak. Postoperative hypotony was most common in pseudo-exfoliative glaucoma cases compared to other glaucoma types. While the most type of glaucoma surgery that was associated with postoperative hypotony was viscocanalostomy combined with express shunt. The adverse effects reported in our study were choroidal effusion and hypotony maculopathy.

6. LIMITATION OF THE STUDY

Our research was a retrospective study: there was missing data in patients’ charts and the follow up period of the research was short, and the sample size was small.

CONSENT

As per international standard or university standard, patients’ written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

As per international standard or university standard written ethical approval has been collected and preserved by the author(s).

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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